

## ATTACHMENT 6

**IN THE CIRCUIT COURT OF BOONE COUNTY, WEST VIRGINIA**

**SCOTT MANDIROLA, DIRECTOR,  
DIVISION OF WATER AND WASTE  
MANAGEMENT, WEST VIRGINIA  
DEPARTMENT OF ENVIRONMENTAL  
PROTECTION,**

**Plaintiff,**

**v.**

**Civil Action No. 07-C-3**

**HOBET MINING, LLC,**

**Defendant.**

**AFFIDAVIT OF JOHN MCHALE**

STATE OF WEST VIRGINIA,

COUNTY OF KANAWHA, To-Wit:

This day personally appeared before me, the undersigned authority, a notary public in and for the County and State aforesaid, John McHale, who after being first duly sworn, deposes and says that he has personal knowledge as follows:

1. My name is John McHale, and I am employed by Patriot Coal Corporation ("Patriot Coal") as its Vice President, Environmental Engineering and Compliance. I am a graduate of The Pennsylvania State University with a Bachelor of Science in Mining Engineering awarded in 1977. I have been employed by Patriot Coal Corporation since its acquisition of Magnum Coal in July 2008, and by Magnum from the time of its acquisition of Hobet Mining and other subsidiaries of Arch Coal, Inc. on December 31, 2005. I have been employed for 32 years by coal companies and engineering firms performing work on behalf of coal companies.

2. Since the entry of the Settlement and Consent Order ("Settlement") in this matter on September 5, 2008, I have been the person within Patriot who has been assigned responsibility for overseeing the execution of its terms. I work with both engineering and operations personnel at Hobet Mining to implement the provisions of the Settlement at the mine. I also direct the activities of the third party consultants who have been retained to undertake engineering projects, including the various Supplemental Environmental Projects (SEPs), required by the Settlement. I am the principal liaison with the West Virginia Department of Environmental Protection (WVDEP), and have prepared and submitted all of the status reports required by the Settlement.

3. I have previously testified and provided affidavits in numerous legal proceedings on behalf of Magnum Coal and Patriot involving the discharge of selenium. I have testified before the Environmental Quality Board in November 2007 in *West Virginia Highlands Conservancy v. McClung*, Appeal No. 2007-10-EQB and Appeal No. 2007-12-EQB; before the United States District Court on July 2, 2008 in *OVEC v. Apogee Coal Company, LLC*, Civil Action No. 3:07-cv-00413; and have provided affidavits in that matter and in *OVEC v. Hobet Mining, LLC*, Civil Action No. 3:08-cv-0088. (Doc 73, 95-2, 114-3, 116-1, and 121-2). I participated on behalf of Patriot in all negotiations in this case that lead to the Settlement entered in this matter between the West Virginia DEP and Hobet Mining, LLC on September 5, 2008.

4. In addition to the payment of a cash civil penalty in the amount of \$1,488,315, Hobet was required by the terms of the Settlement to perform two principal tasks. First, as stated in Section IV. B. 1 of the Settlement, it was required to identify the sources of selenium being discharged from all outlets on the four NPDES permits that are the subject of the case. Second, Hobet agreed to undertake four SEPs, enumerated in Attachments 4.1 through 4.4 of the Settlement that collectively were designed to study the effects of selenium within the Mud River

watershed and Mud River Reservoir, and to identify potential methods of treatment and establish if those methods are both effective and economically viable. By "effective" I mean a treatment that can reduce selenium in whatever form encountered consistently measured both on a percentage basis, and on an absolute basis to achieve a reduction below the current water quality standard of five  $\mu\text{g/l}$ (parts per billion). To be effective the treatment system must also be able to accommodate the significantly fluctuating flows encountered in many of the outlets. By "economically viable" I mean a treatment that Patriot's subsidiaries can afford to install given the existing and reasonably foreseeable financial resources of the company. Although at least two treatment systems have been identified that show promise, neither of them meet the definition I have established for an effective and economically viable treatment.

5. Attached as Exhibit 1 to my affidavit is a letter addressed to Jeff McCormick of DEP dated February 13, 2009 together with a map and table from Potesta & Associates, Inc. This report was submitted to fulfill the requirement of Section IV.B.1 of the Settlement, and was previously supplied to DEP on February 13, 2009. As can be seen from the table that accompanies the letter, the identified outlets demonstrate that discharges of water range widely in volume of flow, consistency of flow and level of selenium discharged. Some outlets demonstrate the propensity to discharge high volumes of water in a consistent flow with levels of selenium above DEP's water quality standard of five  $\mu\text{g/l}$ (parts per billion). Most outlets, however, have intermittent flows at low volumes with varying levels of selenium discharged.

6. Attached as Exhibits 2-A and 2-B to my affidavit are two reports dated August 15, 2008 and June 2009. These documents were submitted, respectively, as an exhibit to the December 5, 2008 status report submitted to DEP in this matter, and as Exhibit D to the June 19, 2009 status report filed with the district court in *OVEC v. Apogee Coal Company, LLC*, Civil Action No.

3:07-cv-00413. Attachment 4.1 of the Settlement required Hobet to undertake a treatment project using a well established treatment technology commonly referred to as "reverse osmosis". Hobet retained the Water & Process Technologies Division of General Electric to perform a pilot scale project that applied reverse osmosis to a location at Hobet. The pilot unit was secured in December 2008 and began operation in January 2009. Within a matter of days, fouling of the membranes in the reverse osmosis equipment, even with the built-in filtration cartridge that was integrated in the modular pilot system, was so severe that GE recommended that the pilot project be discontinued until additional pre-treatment filtration was installed. GE proposed a new system to accomplish that purpose that would have nearly doubled the cost of the pilot study. For that reason, and because Patriot had agreed to engage in a pilot project using another variation of reverse osmosis in settlement of its two federal district court actions, the GE reverse osmosis project was abandoned with the consent of the DEP. GE's final report that summarizes the technical problems associated with utilizing reverse osmosis in a mining application is provided as Exhibit 2-B. Attachment 4.1 required that up to \$750,000 be utilized to demonstrate the feasibility of reverse osmosis treatment. Because the pilot project was cut short, approximately \$56,000 has been spent for the project.

7. Attached as Exhibit 3 to my affidavit is a document found as Exhibit A to the consent decrees entered in the two federal court actions at Civil Action No. 3:07-cv-00413 and Civil Action No. 3:08-cv-0088 dated March 19, 2009. The reverse osmosis systems in these pilot studies employ a vibratory feature known as Vibratory Shear Enhanced Process (VSEP) patented and manufactured by New Logic Research, Inc. Two pilot projects have been undertaken at Hobet and Apogee Coal. These will conclude in August 2009 after which New Logic will prepare a report that describes the performance of their system. A consulting engineering

company, CH2M HILL, which has advised Patriot, will critique New Logic's evaluation. For example, the same type of membrane fouling problems encountered by GE has affected the VSEP pilot system. New Logic has attempted to overcome fouling by rigorous cleaning of the membranes. Several hundred gallons of spent cleaning fluid have been accumulated by New Logic at both Hobet and Apogee that it has agreed to remove and properly dispose of at the close of the projects. We are required by the terms of the federal district court consent decrees to complete this process which I do not expect to be final until early November.

8. Bradley Culkin, Ph. D., a vice president of New Logic testified under oath in one proceeding before the federal district court that the VSEP reverse osmosis system was "guaranteed" to work. Although I cannot make a final conclusion about the efficacy or cost of New Logic's VSEP system, we have observed similar problems that affected GE's reverse osmosis pilot project. Two other fundamental issues will also need to be resolved before one could determine if the VSEP reverse osmosis system is effective and economically viable. The water that is treated and discharged by reverse osmosis, commonly referred to as "permeate", is pure in the sense of being sterile. It contains no minerals or salts of any kind and therefore is unknown in any West Virginia stream. No aquatic life is believed to be able to exist in such an environment. Therefore, before reverse osmosis could be employed, some decision would need to be made by the DEP about how much permeate measured as a percentage of stream volume can be discharged into a body of water. In turn, this is a difficult judgment as every discharge point can be measured by its base flow, its average annual flow and its peak flow, and variability between the base and the peak flows can be a multiple of hundreds. A final, and even more obvious problem, is how to dispose of the mineral pollutants including the fractional portion of selenium, captured by the treatment. This by-product is commonly referred to as "concentrate".

During the course of the pilot project the small volume of the concentrate, together with the permeate, have been discharged back into our sedimentation pond where it mixes with the water captured by the pond. Like the cleaning fluids being accumulated by New Logic, disposal of significantly greater quantities of concentrate would be required if the full scale treatment were adopted or ordered by the DEP. Additional time is needed to evaluate the costs associated with this step.

9. Attached as Exhibits 4-A and 4-B to my affidavit are two reports dated August 14, 2008 and June 1, 2009. These documents were submitted, respectively, as Exhibit 3-A to the December 5, 2008 status report submitted to DEP in this matter, and as Exhibit C to the June 19, 2009 status report filed with the district court in *OVEC v. Apogee Coal Company, LLC*, Civil Action No. 3:07-cv-00413. Attachment 4.2 of the Settlement required Hobet to undertake a treatment project using an alternative treatment technology other than reverse osmosis or a system using zero valent iron. Hobet retained the Water & Process Technologies Division of General Electric to perform a pilot scale project that applied a biological system patented by GE and known as ABMet at a location at Hobet. The pilot unit was secured in January 2009 and was operated between February and May 2009. We have concluded that the ABMet pilot system can remove elemental selenium below the DEP water quality standard of five  $\mu\text{g/l}$ . Whether a full scale ABMet treatment system could operate reliably under fluctuating flows is unknown. The cost of the process, however, is prohibitive. Because the pilot project was less expensive than anticipated when the Settlement was entered, approximately \$154,207 has been spent for the project. Attachment 4.2 of the Settlement required that up to \$750,000 be utilized to demonstrate the feasibility of this alternative treatment.

10. Attached as Exhibit 5-A and 5-B to my affidavit is a report dated May 1, 2009 from Global Materials Technology and ShipShaper, LLC, and an affidavit dated February 2, 2009 by John Sawyer, Ph. D of the Mid-Atlantic Technology Research and Innovation Center (MATRIC). These documents were submitted, respectively, as Exhibit B to the June 19, 2009 status report filed with the district court in *OVEC v. Apogee Coal Company, LLC*, Civil Action No. 3:07-cv-00413 and as Exhibit 2 in the Sixth Status Report filed with the Court in the same action. Representatives of both groups have engaged in research and field projects over the last year that apply iron, fabricated into different materials, to chemically bind the selenate form of selenium to elemental iron. As explained in the affidavit of Paul Ziemkiewicz, Ph. D., attached as Exhibit 7-B some use of iron materials to treat water discharges that contain selenium appears to be the most promising treatment technology identified, particularly at outlets that have low and intermittent flows.

11. Attached as Exhibit 6 to my affidavit is a report dated January 26, 2009 from Tim Harrison of CH2M HILL. This company previously provided this document as Exhibit 4, Task 6 of 6, attached to the Sixth Status Report submitted to the district court in *OVEC v. Apogee Coal Company, LLC*, Civil Action No. 3:07-cv-00413. Although this estimation of the relative costs of treatment systems is considered to be a Class 5 cost estimate (-50% to +100%) based on the American Association of Cost Engineers' estimate classification system, meaning that the actual capital and present value operating costs could range by that percentage, it represents the best estimate that Patriot has regarding the estimated costs of treating selenium using each technology identified.

12. Attached as Exhibits 7-A and 7-B to my affidavit are two reports in the form of affidavits dated June 5, 2009 and August 28, 2009 from Paul Ziemkiewicz, Ph. D of the Water Research

Institute of West Virginia University. The Water Research Institute was retained to undertake that work required by Attachment 4.3 of the Settlement entered in this matter. Exhibit 7-A was previously submitted by Dr. Ziemkiewicz as Exhibit F to the status report provided to the district court in *OVEC v. Apogee Coal Company, LLC*, Civil Action No. 3:07-cv-00413. Exhibit 7-B is an update of the results of that work, and identifies additional work that remains to be performed to implement strategies to manage and limit the discharge of selenium from both active and previously mined areas known to contain sources of selenium.

13. Attached as Exhibits 8-A and 8-B to my affidavit are two documents in the form of a report and an affidavit dated February 12, 2009 and August 28, 2009, respectively, from Mindy Armstead, Ph. D, a Senior Scientist with Potesta & Associates, Inc. Dr. Armstead was retained to undertake that work required by Attachment 4.4 of the Settlement entered in this matter. Exhibit 8-A was previously submitted by Dr. Armstead as Exhibit H to the March 20, 2009 status report provided to the DEP. Exhibit 8-B is an update of the results of that work, and identifies additional work that remains to be performed. The affidavit does conclude that based on the sampling conducted to date that large and diverse populations exist, that those populations appear comparable to reference settings of other lakes, and that the limited number of species sampled are not showing the deformities predicted by previous examination. The affidavit also concludes that insufficient sampling has been performed to conclude that no environmental effects on aquatic populations found within the Mud River watershed and reservoir can be attributed to selenium.

14. Based on this information, I cannot conclude that any treatment system that has been identified is both effective and economically feasible for application at all outlets. At outlets where selenium has oxidized, is mobile and is being discharged in the form of selenate, some

variation of ZVI appears to be the most promising treatment at those locations where flows are low or intermittent. At outlets where flow is constant, but highly variable based upon storm water discharges no treatment yet identified can be considered effective. Moreover, until DEP can determine what percentage of a variable and fluctuating flow is required to be treated and to what level, it is impossible to design any system. In turn, the absence of such a standard makes it impossible to determine if such a system is economically feasible.

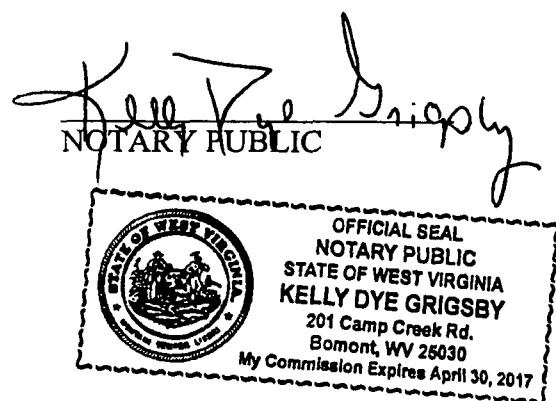
FURTHER THIS AFFIANT SAITH NOT.



John McHale

TAKEN, SUBSCRIBED and SWORN to before me on this the 28th day of August, 2009.

My commission expires April 30, 2017



IN THE CIRCUIT COURT OF BOONE COUNTY, WEST VIRGINIA

SCOTT MANDIROLA, DIRECTOR,  
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MANAGEMENT, WEST VIRGINIA  
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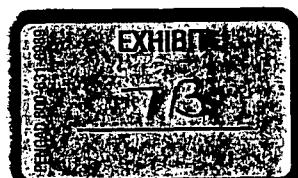
AFFIDAVIT OF PAUL F. ZIEMKIEWICZ, PhD

STATE OF WEST VIRGINIA,

COUNTY OF MONONGALIA, To-Wit:

This day personally appeared before me, the undersigned authority, a notary public in and for the County and State aforesaid, Paul Ziemkiewicz, PhD, who after being first duly sworn, deposes and says that he has personal knowledge as follows:

1. I am employed by Water Research Institute of West Virginia University, in Morgantown, West Virginia as its Director. In my position I am primarily responsible for developing methods to address the State's priority problems related to water quality and management. for the rivers and streams in West Virginia and surrounding states, and how various life forms respond to a variety of stresses and influences imposed by external forces. I supervise employees of the Institute in the preparation of studies, the sampling, collection and evaluation of contaminants in the aquatic environment, and the interpretation of that data. I received a PhD in Forest Ecology from the University of



British Columbia, Vancouver, British Columbia in 1979. I have been employed by the Water Research Institute in my current and previous capacities for 21 years, and have a total of 31 years of professional experience in the study and evaluation of the environmental effects of mining and the mitigation of those effects.

2. As explained in the Affidavit of John McHale provided in this matter, the Water Research Institute was retained by Patriot Coal to provide scientific and technical assistance in complying with Attachment 4.3 of the Consent Order and Settlement entered between the West Virginia Department of Environmental Protection and Hobet Mining on September 5, 2008. The scope of work that WRI has agreed to undertake is found in the document dated June 5, 2009 and attached to the affidavit of John McHale as Exhibit 7-A. I have been the principal investigator in this work and have supervised others in performing the assignments required.
3. I have previous experience in identifying and evaluating the presence of selenium and other chemical elements and in the aquatic environment of the state. I also testified on behalf of the coal industry in the November 2007 proceeding before the West Virginia Environmental Quality Board, *West Virginia Highlands Conservancy v. McClung*, Appeal No. 2007-10-EQB and Appeal No. 2007-12-EQB.
4. As expressed in Exhibit 7-A, WRI's scope of work comprises three broad issues: first, to determine Hobet's relative contribution of selenium to sediment in the Upper Mud River Reservoir; second, to determine Hobet's relative contribution to water column selenium concentrations and loading; third, to quantify fish and insect tissue selenium concentrations and determine any effects on larval fish. In this work we have collaborated closely with Dr. Pat Mazik, an aquatic toxicologist with the US Fish &

Wildlife Service, and an adjunct professor at WVU, Dr. Armstead at Potesta & Associates as well as researchers at the West Virginia DEP.

5. To achieve these objectives, it is necessary to study the sediment present in both the tributaries of the Mud River as well as the reservoir. Our research started in October 2008 and the first phase of our program will be completed in fall 2009. Our research program addresses this goal by three approaches. First, we have collected sediment samples in streams above and below Hobet Mine, the reservoir and the control area in Left Fork where little or no mining has been known to occur. Second, we have quantified total selenium in the water and sediments. Selenium testing of fish tissue is currently underway. Third, based on historic data we will estimate the average selenium loading from Hobet.
6. It is also necessary to study the selenium present in the water column in both the tributaries of the Mud River as well as the reservoir. Our research has accomplished this goal by three approaches. First, we have collected monthly samples at 15 designated stream and reservoir locations in the watershed. Second, we have sampled streams above and below the Hobet Mine and control streams uninfluenced by Hobet's mining. Third, we have developed the mass balance of selenium inputs to the reservoir to quantify the proportion contributed by Hobet as opposed to other sources.
7. Based upon our work we have concluded that the selenium mineral phase that creates the greatest concern environmentally is one that mimics pyrites, meaning that it will dissolve and become mobile upon oxidation and leaching. Upon oxidation, the mineral iron selenide dissolves and ultimately releases selenite, which is soluble but easy to precipitate. Selenite is believed to be the most biologically available form of selenium,

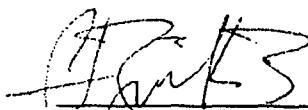
and thus poses the greatest potential risk in the food chain. Selenite slowly oxidizes to selenate, which is soluble and is almost impossible to precipitate to below 5 ppb. It is, however, less toxic than selenite.

8. For purposes of developing treatment strategies, our research has informed us that it is most desirable to treat sources of selenium as close to the known source as possible to maximize contact with selenite because selenite is easiest to treat, meaning it bonds readily with certain iron containing materials. Therefore, segregating the majority of the selenium bearing rock while mining, and treating it so that it cannot release selenate is the optimal strategy. Also, while the oxidation of selenite to selenate is slow, our research has indicated that by the time water leaves the mined area, much of the selenite has oxidized to selenate. As a result, discharges from mines generally contain mostly selenate. Therefore, it is necessary to develop strategies to treat selenate. Treatment is difficult because of selenium sources are numerous and remote, the sources are frequently located in narrow valleys, and the flows and concentrations are variable.
9. Our research has identified at least four likely treatment strategies that may be applicable depending on whether the selenium is found predominantly in the selenite or selenate form. These include adsorption or co-precipitation by Fe(III) hydroxides (also known as ferrihydrite), reduction by Zero Valent Iron, reduction (adsorption) by Fe(II,III) mixed hydroxides (green rust), and biological (bacterial reduction/metabolism) mechanism such as the GE ABMet system already piloted by Hobet. The WRI developed the original Zero Valent Iron or ZVI treatment and continues to collaborate with investigators studying biological reduction and other methods for selenium removal.

10. We have concluded that both ferrihydrite and ZVI methods mitigate selenium to some degree. Ferrihydrite is inefficient for selenate, especially in waters containing appreciable concentrations of sulfate, but removes selenite to <5 ug/L. As DEP currently requires material handling plans when selenium is identified in strata encountered during coal removal, the use of ferrihydrite as part of the treatment strategy merits greater evaluation. By comparison, ZVI removes selenate and selenite, but currently requires long contact times.

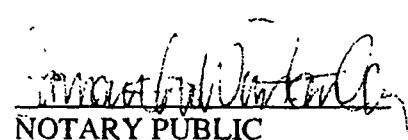
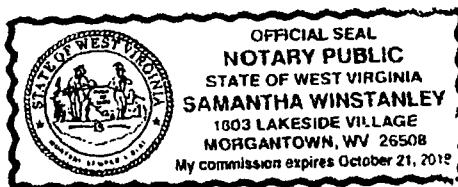
11. Additional research is necessary in order to understand the phenomena encountered at Hobet, and other previously mined sites across the state. At this time we cannot conclude that a single treatment strategy is likely to be effective at all locations and in all applications. What does appear likely is that a successful selenium strategy will employ a suite of control techniques when applied on a watershed basis.

FURTHER THIS AFFIANT SAITH NOT.

  
\_\_\_\_\_  
Paul F. Ziemkiewicz, PhD

TAKEN, SUBSCRIBED and SWORN to before me on this the 28th day of August, 2009.

My commission expires 10/21/2018.

  
\_\_\_\_\_  
NOTARY PUBLIC

IN THE CIRCUIT COURT OF BOONE COUNTY, WEST VIRGINIA

SCOTT MANDIROLA, DIRECTOR,  
DIVISION OF WATER AND WASTE  
MANAGEMENT, WEST VIRGINIA  
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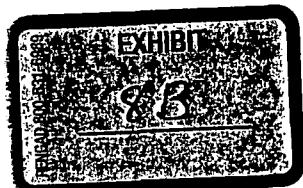
AFFIDAVIT OF MINDY Y. ARMSTEAD, Ph.D.

STATE OF WEST VIRGINIA.

COUNTY OF KANAWHA, To-Wit:

This day personally appeared before me, the undersigned authority, a notary public in and for the County and State aforesaid, Mindy Y. Armstead, Ph.D., who after being first duly sworn, deposes and says that she has personal knowledge as follows:

1. I am employed by Potesta & Associates, Inc. (POTESTA), of Charleston, West Virginia as a senior scientist. In my position I am primarily responsible for evaluating the aquatic life found in the rivers and streams in West Virginia and surrounding states, and how various life forms respond to a variety of stresses and influences imposed by external forces. I supervise employees of our firm in the preparation of studies, the sampling, collection and evaluation of species found in the aquatic environment, and the interpretation of these data. I received a Ph. D. in Biology, from Virginia Polytechnic Institute & State University in Blacksburg.



Virginia in 1994. I have been employed by Potesta & Associates in my current and previous capacities for 12 years.

2. As explained in the Affidavit of John McHale provided in this matter, POTESA was retained by Patriot Coal to provide scientific and technical assistance in complying with Attachment 4.4 of the Consent Order and Settlement entered between the West Virginia Department of Environmental Protection and Hobet Mining on September 5, 2008. The scope of work that Potesta has undertaken is found in the document dated February 12, 2009 and attached to the affidavit of John McHale as Exhibit 8-A. I have been the principal investigator in this work and have supervised other employees of the firm in performing the assignments required.
3. I have previous experience in identifying and evaluating the presence of selenium in the waters of the state. I have undertaken many studies which evaluated the effects of mining discharges, including selenium, on water chemistry and aquatic life in West Virginia Streams. I evaluated the effects of mining on the aquatic environment with data collected as part of the Programmatic Environmental Impact Statement on Mountaintop Mining and Valley Fills initiated by agencies of the United States and the West Virginia DEP (<http://www.epa.gov/region3/mtntop/index.htm>) which included selenium levels. I also testified on behalf of the coal industry in the November 2007 proceeding in before the West Virginia Environmental Quality Board, *West Virginia Highlands Conservancy v. McCling*, Appeal No. 2007-10-EQB and Appeal No. 2007-12-EQB.
4. As expressed in Exhibit 8-A, POTESA's scope of work comprises four broad issues. First, we have initiated or participated in comprehensive collections of aquatic life in

the Mud River Reservoir and tributaries. Second, we have conducted water quality sampling in the watersheds upstream of the Mud River Reservoir and in the reservoir lake itself. Third, we have performed population studies to determine the number and distribution of species within the watersheds that flow into Mud River Reservoir. Fourth, we are conducting reproductive studies of the aquatic life to determine if numbers and health of individuals of identified species are commensurate with similar environments in Central Appalachia. Information collected to date indicates fish and benthic macroinvertebrate communities present in the aquatic systems reflect expected conditions in mining areas with no effects of selenium apparent at the community level.

5. Individual reproductive effects potentially related to selenium, such as a higher incident of deformity in offspring, have been identified in the Mud River Reservoir. No such information, however, has been presented for the tributaries which feed the reservoir. Additionally, based on the continued apparently successful reproductive events that have been observed in our on-going study, it is not clear that these effects will translate to community level effects. Nevertheless, based upon the data collected and reviewed to date, any suggestion that the aquatic populations in the Mud River reservoir are on the brink of collapse cannot be supported.
6. With individual effects evident and likely related to selenium levels, research into treatment alternatives is prudent to reduce individual effects and prevent community level effects. Additionally, the ability to successfully remove selenium from mining discharges and reduce overall loading will allow me to better determine if individual effects, such as noted deformities, are in fact related to selenium. One control strategy

that DEP has required Hobet to utilize at a pilot level is reverse osmosis. It removes all minerals or salts of any kind found in a natural pond or stream. The water discharged from reverse osmosis treatment, commonly referred to as "permeate", is pure in the sense of being sterile, and therefore is not similar to water found in any West Virginia stream. As aquatic life cannot successfully osmoregulate in the absence of any minerals or salts so this water cannot be released into streams dominated by the mine discharge without treatment or mixing with water containing salts. Assuming reverse osmosis is found to be a viable treatment alternative, some strategy to blend discharged permeate with untreated water must be established before the water can be discharged to streams if aquatic life are to be protected.

7. In addition to completing those tasks already identified and underway, at least two other areas for research are suggested by the data collected and reviewed thus far. First, information on the bioaccumulation potential of selenium can be gained from looking at the first level of selenium uptake which has been termed the "enrichment factor". Additional research into this "compartment" of the aquatic ecosystem may help determine why the bioaccumulation factor at the Mud River Reservoir is higher than observed at other sampled streams or reservoirs. POTESSTA has already begun sampling to develop food chain models in the streams in the watershed, and data collection is underway to develop this information for the reservoir. Additional research is needed to link this information and the newly presented "enrichment factor" to the bioaccumulation rates. The mechanisms for understanding selenium partitioning in the environment are developing and the importance of these data was not clear at the time the Settlement was signed. Additional time to collect this

information will be critical in maintaining the utility of the studies and to manage the selenium levels in Mud River Reservoir and other waters of the state.

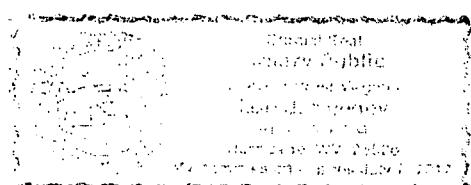
8. A second area of research is the potential for reproductive surveys in mine ponds on the Hobet property. POTESA conducted an in-depth survey of potential selenium sources on the mined property. Several ponds with apparent fish populations were identified that could be used for reproductive study. Water column testing has indicated variable selenium levels in the ponds which present an unexpected opportunity to establish a "dose dependent response" in regard to elevated deformity levels in larval fish. This type of study could demonstrate acceptable tissue levels in fish species and variables which affect bioaccumulation rates. This study would be particularly useful given the proposal by US EPA to change the current water quality standard for selenium from a water column to a tissue based standard.

FURTHER THIS AFFIANT SAITH NOT.

Mindy Y. Armstead  
Mindy Y. Armstead, Ph. D.

TAKEN, SUBSCRIBED and SWORN to before me on this the 28th day of August,

My commission expires July 7, 2017



*J. G. T. G.*  
John G. T. G.